# Investigation of gabbroic rocks associated with the Småland–Värmland granitoid batholith of the Transscandinavian Igneous Belt, Sweden

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## Abstract

Two gabbroic intrusions are presented in this thesis.The objects for this study are to determine age relations between granitoids and gabbroic rocks within TIB and establish whether the mafic rocks are indeed associated with TIB magmatism. Furthermore, to characterise the geochemistry of gabbroic rocks within TIB, determine their petrogenesis, and to use the mafic-ultramafic rocks to elucidate and constrain the tectonic setting during the genesis of these TIB rocks.

Age determinations on zircon, using the techniques Pb-Pb evaporation and ion probe, resulted in intrusion ages of 1692±7 Ma (2σ) and 1790±10 Ma (2σ) for the Rymmen and Eriksberg gabbros respectively. Zircon from a rheomorphic granitoid dyke, intruding the Rymmen gabbro, gave a minimum age of c. 1.77 Ga. Whole-rock Sm/Nd data from the Rymmen gabbro yielded an 1722±120 Ma (2σ) isochron. The epsilon Nd values for the Rymmen gabbro are around 2, and the initial $^{87}Sr/^{86}Sr$ ratios (intrusion age of 1692 Ma) range from 0.70200 to 0.70287, which implies a depleted mantle origin.

The magmas of both intrusions differentiated at relatively high oxygen fugacity, above the fayalite-magnetite-quartz buffer (≥ FMQ+1) and were hydrous (initial $H_2O$ 1-3 wt.%).

The magmas were high-alumina basalts and the intrusions differentiated into olivine gabbro, troctolite, gabbro, anorthositic gabbro, hornblende diorite, and leuco-tonalite. This can be explained by fractional crystallization by in-situ crystal growth.

The compositions of the Rymmen and Eriksberg gabbros are consistent with derivation from a lithospheric melt that separated from a magnesium-rich residual and was modified by fractionation before final emplacement.

Magmatic amphibole formed from a reaction between olivine, plagioclase and interstitial liquid at 865±35°C and 6-8 kbar in the Rymmen gabbro and at 930±65°C and 4-6 kbar in the Eriksberg gabbro. Kelyphytic coronas formed at 800±30°C and 6-8 kbar and at 845±15°C and 4-6 kbar in the Rymmen and Eriksberg gabbros respectively, which indicate mid to lower crust emplacement depths.

Mineral chemistry, isotopic and whole-rock geochemistry, and calculated equilibrium liquids coexisting with the cumulates are consistent with a continental arc setting for the Rymmen and Eriksberg gabbros. Mafic magmas generated in continental subduction zones in the Proterozoic were similar, if not identical, to those of Phanerozoic-Recent age.

*Keywords*: igneous; petrogenesis; gabbro; mafic; cumulate; $fO_2$; hydrous magma; differentiation; fractional crystallization; arc magmatism; Proterozoic; TIB; Baltic Shield

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